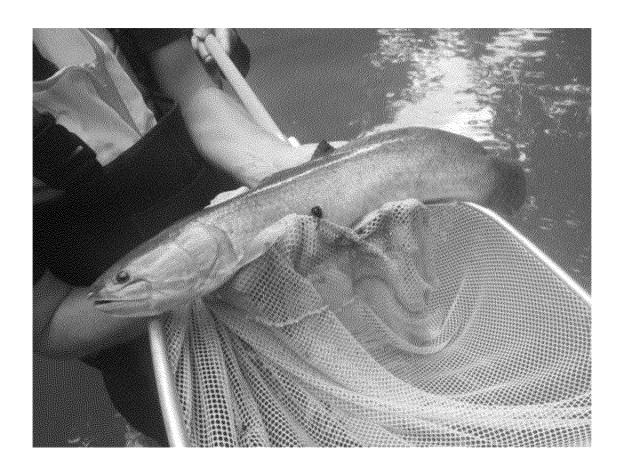
AQUATIC ASSESSMENT REPORT PROPOSED SEVEN HILLS SURFACE MINE WARRICK COUNTY, IN



Prepared for:

Peabody Energy Lynnville, Indiana

Prepared by:

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macroinvertebrates, fish

1. INTRODUCTION

Eco-Tech Consultants, Inc. (Eco-Tech) was contracted by Peabody Energy of Lynnville, Indiana to assess current aquatic conditions at a proposed surface mine in Warrick County, Indiana. The proposed site is within the Seven Hills Permit Area. Eco-Tech has previously performed an aquatic assessment at this location in 2011, along with several other ecological studies.

2. STUDYAREA

The project area is within the Southern Wabash Lowlands (U.S. Environmental Protection Agency [U.S. EPA] Level IV ecoregion). This area is characterized by an undulating landscape consisting of many wide, shallow valleys. Soils are neutral to acid ic, and originally the area was covered with oak-hickory forests on upland sites and mesophytic forests on lowland sites. Row crop agriculture and surface mining are prevalent land uses within the landscape surrounding the project area (Woods et al. 1998).

The site is bound on the north by Seven Hills Road (County Road 750 N) and to the south by Boonville-New Harmony Road (County Road 400 N) on the Daylight, Boonville, and Elberfeld, Indiana USGS Topographic Quadrangles. The permit area lies mostly within the western floodplain of Pigeon Creek. V arious roads and trails occur throughout the project area (Figures 1). The total acreage of the site is 1,680 acres and is predominantly forest with som e cropped areas and former mine impoundments.

Pigeon Creek is a fourth order tributary to the Ohio River. The stream's watershed drains approximately 225 square miles near the southern terminus of the project area (USGS, 2012). Pigeon Creek has been extensively channelized, and remnants of the original course exist as scrolling wetlands and oxbows visible on aerial imagery (Figure 1). The aquatic study area is within the Highland-Pigeon Creek drainage basin (HUC 05140202).

3. METHODS

Potential sample loca tions were identified using GIS data and knowledge of the site collected during previous studies, and three of the sites (AS1, AS2, and AS3) were previously sampled by Eco-Tech (2011b). Six potential sample locations with intermittent or perennial flow reg imes were assessed to determine if suitable habitat was present to maintain aquatic assemblages that could be adequately sampled. Five of the proposed six sites contained flowing water at the time of sampling and were included in the survey: one site on a n intermittent tributary stream and four sites on the mainstem of Pigeon Creek (one upstream of the proposed mine, one at the upper end of proposed mine, and two below the proposed mine area) (Figure s 1). Proposed aquatic site 4 (AS4) did not have adequate stream flow to sample (Appendix A).

Eco-Tech collected information on stream habitat characteristics, water chemistry, and fish and benthic macroinvertebrate communities on August 28 -29, 2017. Data collection was completed using the most current Indiana Department of Environmental Management (IDEM) standard operating procedures obtained from IDEM staff. Ali Meils and Stacey Sobat (pers. comm., 8/23/2017).

3.1. Stream Habitat Description

Sample points were photographed and assessed according to the U.S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocol (RBP) for low -gradient streams and IDEM *Procedures for Completing the Qualitative Habitat Evaluation Index* (QHEI) *B-003-OWQ-WAP-XX-16-T-RO Technical Standard Operative Procedure* (2016) by Ec o-Tech staff. Drainage areas were delineated using the US Geological Survey web interface program StreamStats (v4.1.2; USGS 2012).

3.2. Water Quality Sampling

Water t emperature, dissolved oxygen, and total dissolved solids were measured in the field with a handheld YSI 85 system (YSI Incorporated), and pH was measured with a pHTestr 1 (Oakton). Eco-Tech collected water samples for measurement of additional parameters and delivered them to Rosedale Services, Inc. in Boonville, Indiana. Levels of total iron, total manganese, acidity, alkalinity, and total dissolved solids were determined.

3.3. MacroinvertebrateCommunity Assessment

IDEM Aquatic macroinvertebrate sampling followed the protocol as defined in *Multi-habitat* (MHAB) *Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0 Technical Standard Operating Procedure (2014)*.

Sweep samples were used to collect macroinvertebrates at each aquatic sample point. During the sweep sample, best professional judgment and experience were used to sample as many microhabitats (rootwads, emergent vegetation, woody debris, leaf packs, sandy and silty substrates, and cobble and gravel substrates) as possible, sampling these microhabitats in 1.5-2 meter intervals along 50 meters of shoreline habitat. Due to the fact that the streams are low gradient, and no substantial riffles were present at the proposed sample points, riffle kick samples were modified for short riffles, runs, and glides according to MHAB procedures.

Samples were elutriated, and placed into a white so rting tray. Samples were picked for 15 minutes, and the resulting subsample of invertebrates was preserved in 70 percent ethanol. Invertebrates were identified by Pennington and Associates, Inc. (Cookeville, TN) to "lowest practical taxon" as per IDEM guidance.

Taxa numbers were tabulated to calculate metrics used to produce the Indiana macroinvertebrate Index of Biotic Integrity (mIBI). The metrics were calculated using tolerance values, feeding groups, and habit behavior classifications provided by IDEM in their "Indiana Macroinvertebrate Taxa Attributes" document. Values were then assigned to a ranking system and summed to produce the mIBI according to instructions provided by IDEM in their "Calculating IDEM Macroinvertebrate Index of Biotic Integ rity (mIBI)" document (provided by Ali Meils, IDEM Senior Environmental Manager).

3.4. Fish Community Assessment

Fish communities were sampled using a backpack electrofisher (Halltech Aquatic Research Inc. HT2000B/MK5) according to protocols designed by IDEM's Surface Water Quality Assessment Program (provided by Stacey Sobat, IDEM Section Chief for the Probabilistic Monitoring Program). A length of stream equal to 15 times the stream width was sampled, ensuring equal and representative coverage of both banks. At least one individual per species, per site was preserved as a voucher specimen, as well as any unidentified specimens. All individuals were identified and enumerated by an Eco-Tech biologist familiar with low gradient stream fauna of southwest Indiana.

Taxa numbers were tabulated to calculate metrics used to produce an Index of Biotic Integrity (IBI). The metrics were calculated using sensitivity categories, trophic guilds, reproductive guilds, and additional classifications provided by IDEM in their document entitled "Appendix with Taxa Characteristics for IBI Calculations." Values were then assigned to a ranking system and summed to produce the IBI according to instructions provided by IDEM in their document entitled "Interior River Lowland Callibration Summary" (provided by Stacey Sobat, IDEM Manager Section Chief for the Probabilistic Monitoring Program). Qualitative descriptors for IBI scores were provided by IDEM.

It should be noted that high levels of total dissolved solids were observed w hich can be problematic with electroshocking (Kolz and Reynolds 1989; Burkhardt and Gutreuter, 1995). Typical v oltage levels had to be reduced in order to prevent electrical overloading of the backpack unit. In order to offset this, additional time and s urveyed area was added to the effort at each location. Fish seining was largely impossible due to the high accumulation of coarse woody debris anchored in the fine sediment.

4. RESULTS

4.1. Stream Habitat Description

Stream channels at all five sample sites have been altered by human activities. Pigeon Creek (sites AS1, AS3, AS5, and AS6) has been extensively channelized, and site AS2 is on a channel that appears to be a man-made conveyance built to drain a final cut impoundment from previous surface mining activities. EPA RBP habitat assessment and IDEM Qualitative Habitat Evaluation Index (QHEI) forms are provided in Appendix B. Stream characteristics are summarized in Table 1.

Sites on Pigeon Creek (AS1, AS3, AS5, and AS6) received lower RBP and QHEI scores than AS2 due to a lack of canopy cover, homogeneous fine substrate, and little development of diverse aquatic habitats. Sites AS5 and AS6 received higher QHEI scores than AS1 and AS3 primarily because of greater bank stability and habitat heterogeneity. Channel substrate at all sites is primarily silt/soil; however, a few isolated gravel deposits and areas of exposed hardpan comprised of clay and gravel were noted. Within the sections of Pigeon Creek surveyed fine sediment bars were observed forming in the center of the stream channel. Sites AS1 and AS3 received scoring indicating impaired waterways. Photos of sample locations are provided in Appendix A.

Previous stream habitat analysis noted that stream AS1, AS2, and AS3 received EPA RBP scores of 126, 47, and 126, respectively. The scoring from previous years is similar to the curre nt survey (Appendix D). Site AS2 did receive higher RBP scoring likely due to beaver impact having a stabilizing effect on flow regime and the progressive growth of woody vegetation within the riparian habitat in the years between survey years.

Table 1. Stream characteristics at aquatic sample sites within the proposed Seven Hills Mine in Warrick County, Indiana.

		Dominant		
Sample Site	Flow Regime	Channel Material	IDEM QHEI Score	EPA RBP Score
AS1	Perennial	Silt	46	112
AS2	Intermittent	Gravel	45	88
AS3	Perennial	Silt	48	102
AS5	Perennial	Gravel	53	96
AS6	Perennial	Silt	52	107

4.2. Water QualityResults

Physical and chemical parameters measured at the five aquatic sample sites are provided in Table 2. These measurements will provide monitoring data, which can be compared to previous conditions. Water quality standards for aquatic life in Ohio and Illinois River from Indiana's Administrative Code, Minimum Surface Water Quality Standards (327 IAC 2-1-6), have a dissolved oxygen (DO) lower standard of 4.0 mg/L. All sample sites from this survey were at or below this standard, indicating a strong organic component in the system and lack of habitat and gradient to adequately oxygenate the water column.

Total dissolved solids (TDS) at all five sites are ele vated. While IDEM does not have an aquatic life standard for TDS, elevated water salinity, as measured by specific conductivity and a dominant component of TDS, has been shown to negatively affect aquatic life in freshwaters (U.S. EPA 2016). This parameter may reflect anthropogenic land use influences in the watershed and may also be driven by a strong groundwater hydrologic influence. Although the survey data of TDS and DO indicate water quality may be at levels to cause stress to aquatic organisms, it was not determined if these results are from naturally occurring sources or from

anthropogenic effects. All other parameters were within typical water quality standards for unimpaired waterways.

Table 2. Physical and chemical measurements of water in streams within the proposed Seven Hills Mine in Warrick County, Indiana.

Parameter	AS1	AS2	AS3	AS5	AS6
Temperature (°C)	22.7	25.8	22.9	22.5	23.2
Dissolve Oxygen (DO)	4.00	3.80	3.90	3.87	4.05
рН	8.1	8.2	8	7.9	8.2
Total Dissolved Solids (mg/L)	1440	1100	2110	2230	2070
Total Acidity (mg/L as CaCo3)	<10	<10	<10	<10	<10
Total Alkalinity (mg/L as CaCo3)	313	280	256	344	255
Total Iron (mg/L)	0.16	<0.1	<0.1	<0.1	0.18
Total Manganese (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Total Suspended Solids (mg/L)	<10	<10	11.7	<10	23

Previous physical and chemical parameter by Eco-Tech (2011b) noted that total dissolved solids at sites AS1, AS2, and AS3 were noted to be high at the time of sampling. All other parameters fell within the water quality parameters of the time (Appendix D).

4.3. MacroinvertebrateSamplingResults

Previous macroinvertebrate sampling at AS1, AS2, and AS3 yielded a total of 241 individuals of 32 taxa. The most common taxa sampled at all three sites included clam shrimp (Spinicaudata), narrow-winged damselflies (*Enallagma* spp.), net-spinning caddisflies (*Cheumatopsyche* spp.), and riffle beetles (*Stenelmis* spp.) (Appendix D).

Macroinvertebrate from 2017 sampling effort yielded a total of 1,196 individuals of 77 taxa. Macroinvertebrate IBI scores ranged from 34 to 38, and IDEM considers streams scoring less than 36 to be impaired. All sites exhibited some level of stress to the faunal community making them borderline impaired reaches.

Higher metric scoring for individual sites in general resulted from low percentages of Orthocladiinae and Tanytarsini of Chironomidae, non-insects minus crayfish, and tolerant taxa. The low scores obtained for individuals sites in general are the result of several indicators of poor stream health, including the number of EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa, percent shredders and scrapers, and percent collector filterers. The highest score was observed at AS3, and this is due to the fact that the greatest number of individuals and greatest percentage of intolerant taxa were collected there.

While more individuals and taxa were collected in 2017 than in 2011, the taxa observed did not exhibit a high quality macroinvertebrate community. Significant results common among all five sites included narrow-winged damself lies (*Enallagma* sp.), net-spinning caddisflies (*Hydropsyche* sp.), and various midge species (*Polypedilum illinoense* group and *Tanytarsus sp.*).

sites include d small minnow mayflies (Callibaetis Taxa that occurred at four of the five floridanus), dancer dams elflies (Argia sp.), forktail damselflies (Ischnura sp.), net -spinning caddisflies (Cheumatopsyche sp.), and various midge species (Dicrotendipes neomodestus, Glyptotendipes sp., Polypedilum flavum , Ablabesmyia mallochi, Conchapelopia sp., and *Procladius* sp.) The most abundant species found at all five sites was Polypedilum illinoense group (n=220), and the most abundant species from the entire survey effort was Cheumatopsyche sp. (n=243; Appendix C). Some of the taxa (midges and damselflies) are commonly found in lentic habitats (pools) in vegetation, mud, debris, or rootwads, which are common in Pigeon Creek. The small minnow mayflies and net-spinning caddisflies, are often found in areas with more flowing water. Taxa richness was greatest at AS1, AS3, and AS5 most likely to greater habitat heterogeneity between riffle, pool, woody debris, root wad, and leaf pack habitat.

Table 3. Metrics used to calculate the macroinvertebrate Index of Biotic Integrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

Parameter	AS	51	AS	52	AS	53	AS	55	AS	56
	Value	Score								
Number of Taxa	34	3	20	1	34	3	32	3	30	3
Number of Individuals	216	3	212	3	123	1	495	5	150	3
Number of EPT Taxa	4	1	3	3	2	1	8	3	5	1
% Orthocladiinae + Tanytarsini of Chironomidae	3.2%	5	6.6%	5	4.1%	5	3.4%	5	6.7%	5
% Non-insects Minus Crayfish	7.9%	5	4.7%	5	5.7%	5	1.0%	5	10.0%	5
Number of Diptera Taxa	15	5	8	3	20	5	16	5	14	5
% Intolerant	29.6%	3	42.9%	5	0.0%	1	18.0%	3	14.7%	1
% Tolerant	6.5%	5	3.8%	5	14.6%	3	12.7%	3	8.0%	5
% Predators	18.5%	3	3.3%	1	29.3%	3	17.4%	1	22.0%	3
% Shredders + Scrapers	0.5%	1	0.5%	1	2.4%	1	2.2%	1	2.0%	1
% Collector-Filterers	39.4%	1	87.7%	1	13.8%	3	20.6%	1	28.0%	1
% Sprawlers	2.3%	1	0.5%	1	10.6%	5	3.4%	3	6.0%	5
Total Scores		36		34		36		38		38

^{*&}lt;36=impaired, ≥36=unimpaired.

4.4.Fish SamplingResults

Previous sampling on Pigeon Creek (Eco -Tech, 2011b) indicated qualitative ratings of fair (AS1 and AS3) and poor (AS2), yielding a total of 295 individuals and 25 taxa. Channel catfish (Ictalurus punctatus), green sunf ish (Lepomis cyanellus), and bluegill (Lepomis macrochirus) were found at all three sites. Other relatively populous species (>10 individuals) included black bullheads (Ameiurus melas), steelcolor shiners (Cyprinella whipplei), blackstripe topminnows (Fundulus notatus), and golden shiners (Notemigonus chrysoleucus), and two species known to be sensitive to and/or intolerant of pollution were captured: long -eared sunfish (Lepomis megalotis) and dusky darter (Percina sciera). No species captured in the 2011 survey is listed as

threatened or endangered by the U.S. Fish and Wildlife or the state of Indiana (Eco-Tech 2011b; Appendix D).

In 2017, sampling yielded 17 fish species. IBI scores ranged from 17 to 24. Fish communities at four sample sites were classified as indicative of poor stream habitat and one site's community was classified as very poor (58-60=Excellent, 48-52=Good, 40-44=Fair, 28-34=Poor, 12-22=Very Poor, <12=No Fish). The low scores obtained at all five sites were caused by low overall species richness, low minnow species richness, no occurrences of sucker species or sensitive species, and low percentages of carnivorous or pioneer fish and simple lithophiles (fish that lay eggs on rocks). IBI scores for 2017 are lower than the previous survey (Appendix D). Lower fish diversity and number captured individuals could possibly be explained by higher water temperatures, which also increased the ambient conductivity (Kolz and Reynolds 1989; Burkhardt and Gutreuter, 1995), and so fish bio-regulatory processes and behavior were adversely affected for electroshock sampling. The same backpack shocker and operator were used for both surveys. Fish seining to offset the reduction of captured fish was prevented by coarse woody debris distributed throughout the sites on Pigeon Creek.

Table 4. Fish community metrics used to calculate the Index of Biotic Integrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

	A:	51	A:	S2	A:	53	A:	S5	A	S6
Parameter	Value	Score								
Number of Species	7	1	5	5	8	1	8	1	6	1
Number of Minnow										
Species	2	1	0	0	0	0	3	0	0	0
Number of Sunfish										
Species	4	1	3	3	4	1	1	1	3	1
Number of Sucker										
Species	0	0	0	0	0	0	0	0	0	0
Number of Sensitive										
Species	1	1	0	0	1	1	1	1	2	1
% Tolerant	30%	3	21%	5	39%	3	32%	3	0%	5
% Omnivore	17%	3	0%	0	0%	5	0%	5	0%	5
% Insectivore	0%	0	0%	0	0%	0	0%	0	0%	0
% Pioneer	N/A		17%	5	N/A		N/A		N/A	
% Carnivore	10%	1	N/A	0	17%	1	4%	1	10%	1
Total # Individuals	30	1	29	1	18	1	50	1	21	1
% Simple Lithophilic										
Individuals	0%	0	0%	0	0%	0	0%	0	0%	0
% Individuals with										
Deformities	0%	5	0%	5	0%	5	0%	5	0%	5
Totals		17		24		18		18		20
		Very		Poor		Very		Very		Very
Qualitative Rating		Poor		- 001		Poor		Poor		Poor

^{*58-60=}Excellent, 48-52=Good, 40-44=Fair, 28-34=Poor, 12-22=Very Poor, <12=No Fish

Green sunfish (Lepomis cyanellus), bluegill (Lepomis macrochirus), and spotted bass (Micropterus punctalatus) were found at all three sites. These are habitat gen eralists, and green sunfish are especially tolerant of adverse habitat conditions , such as sedimentation and low oxygen. Relatively populous species (>8 total individuals) included steelcolor shiners (Cyprinella whipplei), mosquitofish (Gambusia affinis), warmouth (Lepomis gulosus), long-eared sunfish (Lepomis megalotis), suckermouth minnow (Phenacobius mirabilis), and bluntnose minnow (Pimephales notatus). These species are typical inhabitants of pools and vegetation beds of small to medium-sized tributaries of the Ohio River. To a certain degree, t hey are able to tolerate habitat conditions found in Midwestern low-gradient streams, including warm water temperatures, relatively low oxygen, sedimentation, and non -point source pollution. Only two species which are known to be sensitive to and/or intolerant of pollution were captured: long-eared sunfish (Lepomis megalotis) and dusky darter (Percina sciera). No species captured in this survey is listed as threatened or endangered by the U.S. Fish and Wildlif e or the state of Indiana.

5. SUMMARY

Streams within the project area display several indicators of disturbance and poor water quality. They have been subject to channelization and show very little development of instream habitat and stable substrate. Water quality measurements show significant stressors to aquatic life in the form of high dissolved solids and low dissolved oxygen. Fish and macroinvertebrate communities at all sites reflect a very tolerant aquatic assemblage that is adapted to low gradient streams with inadequate habitat and water quality issues.

LITERATURECITED

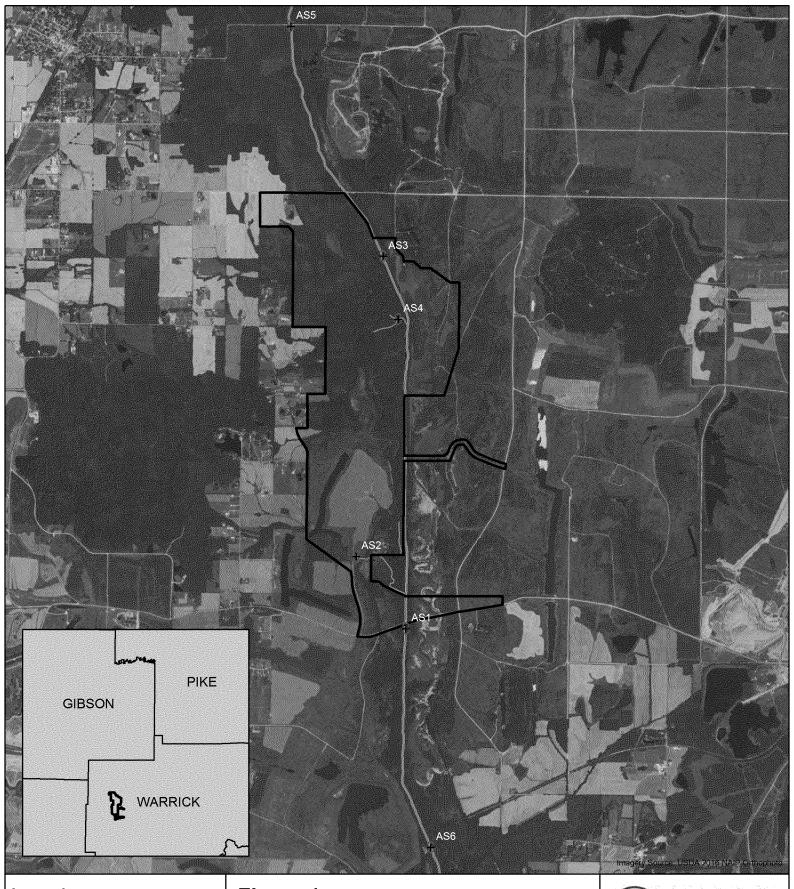
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 Application #S-00357
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FIGURES.

FIGURE 1: PROJECT LOCATION MAP



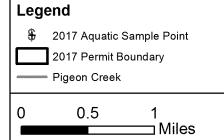


Figure 1:

Aquatic Sample Points

Peabody Seven Hills Mine Warrick County, IN



Drawn by: RRN

Print Date: 9/15/2017

Project: LV2017025

APPENDIX A.

REPRESENTATIVE PHOTOGRAPHS



Photo 1. Sample point AS1 downstream view from bridge intersection



Photo 3. Sample point AS2 downstream view of pool habitat.



Photo 5. Sample point AS3 downstream view.



Photo 2. Sample point AS1 upstream view from bridge intersection



Photo 4. Sample point AS2 downstream view.



Photo 6. Sample point AS3 downstream view.

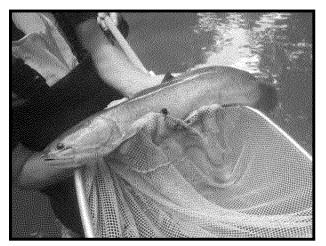


Photo 7. Bowfin (Amia calva) caught at AS3.



Photo 9. Sample point AS5 downstream view from underneath bridge.



Photo 11. Sample point AS6 downstream view.



Photo 8. Sample point AS4 on survey date upstream view. Dry stream bed.

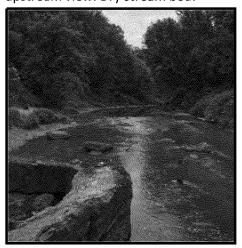


Photo 10 Sample point AS5 upstream view from underneath bridge. Showing clay hardpan.



Photo 12. Sample point AS6 upstream view.

APPENDIX B.

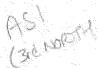
EPA RBP FORMS AND SUPPLEMENTAL STREAM HABITAT FORMS

Multi-habitat (MHAB) Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

IDEM	지점 그 사람들 다음)WQ Biologi		HEI (Qualita		at Evaluat	이 사용에 가르다니다 중) =	
ring (Sample #		bioSample #	Stream	wame SSCEK		Location 34.06617		dy est
1	Surveyor	Sample Date	County	Macro Samp		Habitat			
Z.C	(50 TW)	¥3/2417	Warriell	MARSIS		omplete	QHEI So	core:	52
1] <i>SU</i>	BSTRATE C	heck ONLY Two pr	edominant substrai	e TYPE BOXES;					
	SEST TYPE	S		HER TYPES	ORIG	Check ONE (OI IN		LITY	
PREDOMINA P R	VALUE	PRESENT TOTAL %	PREDOMINANT PR	PRESENT TOTAL!	LIMESTO	NE[1]	S ■ HEAVY	Γ-21	
	DR/SLABS[1		□ HARDPAN				T ☐ MODE	RATE[-1]	Line Sine
	OULDER[9] OBBLE[8]		☐☐ DETRITUS	[3] []	☐ WETLANI		⊢□ NORM		Substrate
	RAVEL [7]		■□ SILT[2]		☐ SANDSTO	ONE[O]	and the second of the second o	engeniarenteriaren	2
□□ SA	MD[6] DROCK[5]		□□ ARTIFICIA (Score natura	L[U] [] [] il substrates; ignore	☐ RIP/RAP ☐ LACUSTR		EXTENS ☐ MODER	SIVE[-2] VATE[-1]	
NUMBE	R OF BEST		nore [2] sludge fi	om point-sources)	☐ SHALE [-1	IJ	NORM/		Maximum
Comm	The State of	☐ 3 or l	ess [0]	and the second of the second	☐ COALFIN	IES [-2]	∄ □ NONE[1]	20
		VER Indicate pre	sence 0 to 3 and es	itimate percent: 0 -/	Absent: 1 Very s	small amounts	or if more comm	on of marci	Inal
quality; 2	Moderate ami	ounts, but not of hi	gnest quality or in :	small amounts of hig	hest quality; 3-	Highest	Αľ	TAUON	
				lers in deep or fast i deep, well-defined,			Check ONE	(Or 2 & ave	
% Amount			% Amount	% Amo	ant	e. Santa da santa da sa	■ MODERA	ATE 25 - 75	5%[7]
868	INDERCUT BA	NKS[1] GVEGETATION[1]	1 ≥ POOLS ROOTM	> 70cm [2] {] /ADS [1] { }	AQUATIC MAC				
20 1 S	HALLOWS (II)	I SLOW WATER)[LOGSORWOO			Cover	
<u> 50</u> F	OOTMATS[1]							Maximum	14
Comm	ents	***************************************				**********************		20	
3] CHA	NNEL MOI	RPHOLOGY Ch	ck ONE in each ca	tegory (Or 2 & aver	ige)		Andrea and		
SINUC HIGH		DEVELO ☐ EXŒLLI	MENI MIZI [CHANNELIZAT ∃NONE[6]	TOM	STABIL □ HIGH			
☐ MOD	ERÁTE [3]	☐ GOOD[] ☐ FAIR[3]	i)	RECOVERED[4]	•	☐ MODE	RÁTE[2]	Channel	\
MONE		POOR	j È	RECOVERING [3 RECENT OR NO		□ row[Ŋ	Maximum 20	17 1
Comme								<u> </u>	
4] <i>BAN</i>	K EROSIO	N AND RIPAR	IAN ZONE Che	ck ONE in each cate	gory for EACH B	ANK (Or 2 per	bank & average)	
	ight looking downst EROSION	ream [R KIPA : MilDE MilDE		L R FLOOD P ■ FOREST, SM			r □ conservat	DOM TO LA	GEI11
ÖÖ NO	NE/LITTLE [3	I □□ MODE	ATE 10-50m[3]	□□ SHRUBOR	NDFIELD[2]		☐ URBAN OR I	INDUSTRIA	T.LOJ
	XDERATE[2] AVY/SEVERE[□□ NARRO 1] □□ VERYN	W 5-10m[2]	☐☐ RESIDENTL					IOM[0]
M	is ilector!	□ □ NONE		☐☐ OPEN PAST			predominant lar m nparlan.	Riparian	
Comme	inte				A TENSON			Maximum	4
		ND RIFFLE/R	UN QUALITY					1.0 L	Y
	MUM DEPT ONE (ONLY!)		EL WIDTH	A Committee of	RENT VELO	and the same of th		eation Poten	
□ >1	Control of the contro		(Or 2 & average) TH > RUFFLE WID '		heck ALL that ap BNTIAL[-1] 🔠		[] F	and commen himary Conta	ct
	-<1m[4]		TH = RIFFLE WID	H[1] ☐ VERY!	AST[1]	INTERSTITIA	և[-ո] 🗆 🤄	Secondary Co	ntact
	-<0.7m[2] -<0.4m[1]	□ POOLWID	TH < RIFFLE WID		RATE[1]	INTERMITTE EDDIES[1]	MI[-Z]	Pool/ Current	ากใ
_ □ <0						reach – pools a	ind riffles.	Maximum	14 1
Comme		riffles: Best areas	must be large enou	igh to support a pop	oulation	·	***********	12k	
of riffle	-obligate speci	es;		heck ONE (Or 2 & a	the state of the s		☐ NORIFE		
	DEPTH	RUN DE	PTH R	IFFLE/RUN SU STABLE(e.g., Col			RUN EMBEI KONE[2]	DDEDNE:	SS
■ BEST	AREAS 5-10cr	n[1] 🖩 MAXOM	UM < 50am [1] □	MOD.STABLE (e.	g., Large Gravel)	[1] 🔳 L	OW[1]	Riffle/	<u> </u>
☐ BEST#	AREAS < 5 cm Imetric			UNSTABLE (e.g.,		d)[0] 🗆 N	MODERATE[0]	Run	13,1
Comme	nts						XTENSIVE [-1]	8 5	للكا
6] GRAI	DIENT (2.4	4 ft/mi)	☐ VERY LOW - L		POOL: 4/6	2) %GLID		Gradient	
DRA	TNAGE ARI	EA (>07,≪mi²)	☐ MODERATE [6 ☐ HIGH-VERY!	-10] [[] [] [] [] [] [] [] [] [] [] [] [] []	6RUN: ZG	%RIFF		Maximum 10	81
		3.000						k	
								*f)\$	M 07/06/10

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)) ; ; ; ; CIT/90//D M3CI ☐ Fabe bank ☐ Manure ☐ Lagoon BMPs: Construction Seriment ☐ Logging ☐ Imigation ☐ Cooling □WashH_O□ Tie□H_OTable Row: □Natural □ Stagnant □WWIP □ CSO □ NPDES □ Hardened □ Dirt & Gine Brosion: ☐ Bank ☐ Surface □Wetland □ Park □ Golf ☐ Atmospheric deposition □ Contaminated □ Landfill Mine: \[\text{Acid} \[\text{O.camy} ☐ Industry ☐ Urban □ Lawn □ Home E-ISSUES OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) Leveed: One sided Both banks Snag: | Removed | Modified □Spray □ Istants □ Scoured Successon: | Young | Old Bedload: ☐ Moving ☐ Stable ☐ Impounded ☐ Desicrated □Rood control □ Drainage D-MAINTENANCE □ Armound □ Stamps □ Refocated □ Cutoffs □ Active □ Historic □ Public □ Private Pool: □ > 100 ft² □ > 3 ft E E C-RECREATION HOMOPY Load Looking quateum (> 10m, 3 readings < 10m, 1 reading in michol); Roand to the nearest whole parent **Total Average** ☐ Sludge deposits ☐ CSOs/SSOs/Outfalls ☐ Nuisance odor ■ Trach/Litter □ Olshean Right B-AESTHETICS % Middle Stream Drawing: AS % SOMMENT ☐ 10%-<30% ☐ <10%-Closed □ 55%-<85% ■ 30%-<55% mado-%ss< □ 1 A-CANOPY uado% 21



STREAM NAME	LOCATION
STATION#_ REACHID#_	STREAM CLASS
UTM N UTM E	RIVER BASIN
STORET#	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE REASON FOR SURVEY TIME PM

	Habitat		Conditi	on Category	
	Parameter	Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potentia adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat, lack of habitat obvious; substrate unstable or lacking.
	SCORE 🔑	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 (
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent, root mats and submerged vegetation common.	Mixture of soft sand, mud or clay, mud may be dominant; some root mats and submerged vegetation present.	bottom; little or no root mat; no submerged	Hard-pan clay or bedroo no root mat or vegetatio
L	SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
	3. Pool Variability	Even mix of large- shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large- deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent
	SCORE 17	20 19 18 17 16	15 14 13 (12)11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development, more than 80% of the bottom changing frequently; poo almost absent due to substantial sediment deposition.
Ĺ	SCORE 10	20 19 18 17 16	15 14 13 12 11	(6) 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	both lower banks, and minimal amount of	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
S	CORE 17	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat		Conditio	n Category	
Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabin or cement, over 80% of the stream reach channelized and disrupte Instream habitat greatly altered or removed entirely.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length I to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE /	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional sears.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 🤚 (RB)	Right Bank 10 (9/	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes, vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	represented; disruption evident but not affecting full plant growth potential to any great extent; more	obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 🐇 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 🥳 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	18 meters; human activities have impacted	12 meters; human activities have impacted	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE(LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0

Total Score 112

Multi-habitat (MHAB) Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0

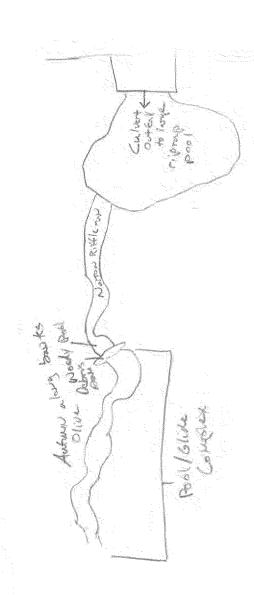
Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

Sample #)WQ Biologi	cal Studies (bioSample #	the contraction of the contracti		Location
"[] <u>[_As-2</u>		· · · · · · · · · · · · · · · · · · ·	Unioned Tribute	inglish in the city of the commence of the city of the	38.103602,-87.40612
Surveyor	Sample Date	County	Macro Sample Type		OUET Cooks 77
e concu	1-8122/17	12357615	1 11/4/3/15.55	Complete	QHEI Score: 42
INSTREAM CO INSTREAM CO Illty; 2 Moderate amo Illty in moderate or gi t is stable, well devel amount UNDERCUT BAI	estimate % and s PRESENT TOTAL % P R P R P R P R P R P R P R P R P R P R	Check every type p OT PREDOMINANT P R HARDPAN CHECK CI SILT[2] ARTIFICIA (Score natur more [2] sludge f less [0] Described to 3 and c lighest quality or in g., very large bould deep/fast water, or Amount 1 POOLS 1 ROOTS	PRESENT TOTAL % PRESENT TOTAL	DRIGIN MESTONE [1] LS [1] ITLANDS [0] RDPAN [0] NDSTONE [0] V/RAP [0] USTRINE [0] ALE [-1] AL FINES [-2] -Very small amounts lity; 3-Highest ge diameter log pools.)	Or 2 & average) QUALITY HEAVY [-2] MODERATE [-1] MODERATE [-2] EXTENSIVE > 75% [11] MODERATE 25 - 75% [7] SPARSE 5 - < 25% [3] MEARLY ABSENT < 5% [1] MODERATE 25 Maximum 20 MODERATE MODERATE
NUOSITY HIGH [4] MODERATE [3] LOW [2] NONE [1]	DEVELO DEVELO FAIR [3 POOR [PMENT ENT[7] [5] [tegory (Or 2 & average) CHANNELIZATION NONE[6] RECOVERED[4] RECOVERING[3] RECENT OR NO RECOVER	■ LOW	[3] ERATE[2] Channel
mments			10 (10 (10 (10 (10 (10 (10 (10 (
River right looking downston REOSION NONE/LITTLE[3] MODERATE[2] HEAVY/SEVERE[.	EM L R KIPA EM WIDE ON MODE ON NARRO L] ON VERYI ON NONE	.RIAN WIDTH >50m[4] RATE 10-50m[3] XW5-10m[2] VARROW[1] [0]	☐☐ PENCED PASTURE [1 ☐☐ OPEN PASTURE, ROV	UALITY L D[2] NEW FIELD [1] I fodicate	R R CONSERVATION TILLAGE [1] URBAN OR INDUSTRIAL [0] MINING /CONSTRUCTION [0] predominant land use(s) Om riparian. Maximum 10
POOL/GLIDE A AXIMUM DEPTI heck ONE (ONLY!)] >1m[6]	H CHANN Check ONE	IEL WIDTH (Or 2 & average)	CURRENT Check ALL TH[2] TORRENTIAL[-	that apply	Recreation Potential (Circle one and comment on bac
0.7-<1m[4] 0.4-<0.7m[2] 0.2-<0.4m[1] <0.2m[0] nments	POOLWII POOLWII	MH=RUFFLEWID MH <rufflewid< td=""><td>TH[1] □ VERYFAST[1] TH[0] □ FAST[1] □ MODERATE[1] Indica</td><td>☐ INTERSITION ☐ INTERMITION ☐ EDDIES[1] te for reach — pools</td><td>ENT [-2] Pool/ Current and riffles Maximum</td></rufflewid<>	TH[1] □ VERYFAST[1] TH[0] □ FAST[1] □ MODERATE[1] Indica	☐ INTERSITION ☐ INTERMITION ☐ EDDIES[1] te for reach — pools	ENT [-2] Pool/ Current and riffles Maximum
ndicate for functional of offie-obligate specie FFLE DEPTH BESTAREAS > 10cm	riffles; Best areas s: RUN DE [2] MAXIM 1[1] MAXIM	must be large enoi (PTH R [UM > 50cm [2] E [UM < 50cm [1] [igh to support a population theck ONE (Or 2 & average) IFFLE/RUN SUBSTR/ STABLE(e.g., Cobble, Bould MOD. STABLE(e.g., Large(UNSTABLE(e.g., Fine Graw	NTE RIFFLE, ler)[2] [] Gravel)[1] [[] el, Sand)[0] []	NO RIFFLE [metric = 0] / RUN EMBEDDEDNESS NONE [2] LOW [1] Riffle/ MODERATE [0] Run EXTENSIVE [-1] Maximum
GRADIENT (66. DRAINAGE ARE		☐ VERYLOW - L MODERATE [6 ☐ HIGH - VERY	-10]		DE: 40 Gradient Maximum 10
Roles	JAM T	(Egrst			10EM 07/06

 N_0

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

A-CANOPY A-CANOPY B-AESTHETICS C-RECREATION Nuisanceagae Nuisanceagae Nuisanceagae Stoke - 655% Excess turbidity Nuisance odor Stoke - 550% Excess turbidity Nuisance odor Stoke - 550% Excess turbidity Nuisance odor Stoke - 650% Excess turbidity Nuisance odor Stoke - 650% Excess turbidity Nuisance odor Stoke - 650% Stoke - 650% Nuisance odor Nuisance odor Stoke - 650% Nuisance odor Stoke - 6	D-MAINTENANCE □ Pubic □ Private □ Active □ Historic Succession: □ Young □ Old □ Syray □ Islants □ Scoured Srag: □ Removed □ Modified Levecd: □ One sided □ Both banks □ Reforated □ Outoffs Betload: □ Moving □ Stable □ Armoured □ Stamps □ Impounded □ Desicrated □ Rood control □ Desirage	E-ISSUES WWYTP CSO NPDES Industry Utran Hardened Dirt & Grime Contaminated Landfill BMPs: Construction Sediment Logging Impation Coding Erosion: Benk Surface False bank Manure Lagoon Wash H., O Tie H., O Table Mine: Acid Quany Row: Natural Sagnant Wettand Pank Golf
		☐ Lawn ☐ Home ☐ Atmesphericdeposition



DEM 07/06/10

PISZ (un NORCH)

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

STREAM NAME		LOCATION			
STATION#_	REACH ID#	STREAM CLASS			
UTM N	UIM E	RIVER BASIN		jurani.	
STORET #		AGENCY			
INVESTIGATORS					
FORM COMPLETE	D BY	DATE	REAS(ON FOR SURVEY	

	Habitat		Conditio	n Category	
	Parameter	Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
ş L	SCORE &	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat, no submerged vegetation.	Hard-pan clay or bedrock no root mat or vegetation
	SCORE / O	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large- shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large- deep, very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.
	SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
raran	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar- formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new- bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pool almost absent due to substantial sediment deposition.
L	SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
***************************************	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools
-	SCORE 17	20 (19) 18 17 16	15 14 13 (12)11	10 9 8 7 6	5 4 3 2 1 0

Habitat Parameter		Condition	on Category	
raiameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gab or cement, over 80% of the stream reach channelized and disrup Instream habitat greath altered or removed entirely
SCORE ()	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length I to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length I to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5)43210
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0
SCORE 🥠 (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream	or mowing minimal or not	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent, more than one-half of the potential plant stubble height remaining.	surfaces covered by vegetation, disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble	Less than 50% of the streambank surfaces covered by vegetation disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE (p (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE (# (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	>18 meters; human activities (i.e., parking :	18 meters; human activities have impacted	12 meters; human ractivities have impacted r	Width of riparian zone <6 neters: little or no iparian vegetation due to iuman activities.
	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE (LB)	ECH Dank 10 9	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		4 1 0

Total Score 88

Multi-habitat (MHAB) Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

IDEM	Sample #	OWQ Biologic	cal Studies Ql bioSample #	IEI (Qualitative Hab	itat Evalua	tion Index) Location
3.	AS-3			PIACON LILLY		3-8.13 6306, 87.402/11
	Surveyor	Sample Date	County	Macro Sample Type	M Habitat	
R.R.	Evo-Tech	18/22/17	LATTHE	MHAR GISUN	Complete	QHEI Score: 💆 🄏
1] 50	IBSTRATE (Check ONLY Two pr estimate % and i	edominant substrate heck every type pres	TYPE BOXES;	Check ONE (C	Ir 2 & average)
PREDOMIN	BEST TYPE		ОТН	and the second s	GIN	QUALITY
PR		PR	PR	PR 🔲 LIMES	TONE [1]	S HEAVY [-2]
	LDR/SLABS[1		■□ HARDPAN[4			ĭ ☐ MODERATE [-1]
	OULDER [9] OBBLE [8]		☐☐ DETRITUS[3] 🗆 🗆 🗆 WETLA B 🗇 💮 🖽 HARDE	NDS[0]	├ NORMAL [0] Substrate
	RAVEL[7]	<u> </u>			TONE[0]	
	AND[6]	DD <u>70</u>	□□ ARTIFICIAL			EXTENSIVE [-2]
	EDROCK[5]		(Score natural	substrates; ignore 🗌 LACUS T		B☐ MODERATE [-1]
NOMBI	EK OF BEST	TYPES: ☐ 4 or i	nore [2] sludge fro		[-1] INES[-2]	NORMAL [0] Maximum I NONE [1] 20
Comm						그림, 뭐 그는 얼룩이 먹는 그 일이다.
2] <i>INS</i>	TREAM CO	VER Indicate pre	sence 0 to 3 and esti	mate percent: 0 -Absent; 1 -Ver	y small amounts	or if more common of marginal
quality; 2	Moderate am	ounts, but not of hi	gnest quality or in sn	all amounts of highest quality; s in deep or fast water, large di	3 -Highest	AMOUNT
that is sta	ble, well devel	oned root wad in d	g., very lange boulder geb/fast water, or de	s in deep of last water, large di ep, well-defined, functional poo	ameter log is 1	Check ONE (Or 2 & average) EXTENSIVE > 75% [11]
%: Amount			% Anjount	*A Amount		☐ MODERATE 25 - 75% [7]
	JNDERCUT BA	NKS[1] GVEGETATION[1]	/ 2 POOLS >	70cm [2] 🔃 💆 OXBOWS, B.	ACKWATERS[1	I ■ SPARSE 5 - < 25% [31]
15 t	SHALLOWS (TA	SLOW WATER)[1	ROOTWA BOULDER :	IS[1]AQUATICM S[1]	ACROPHYTES[] DODYDEBRIS[] □ NEARLY ABSENT < 5% [1]
	ROOTMATS[1]		, 5000 11	o[x] <u>Iv ⊼</u> romoviii	JODI DEBRUST.	Maximum 7 🔿
Comm	Ante			The second secon		20 7
		nnual acv				
☐ HIGH)511Y [[4]	☐ EXŒLLE	MENT C	ory (Or 2 & average) HANNELIZATION NONE[6]	STABII □ HIGH	
☐ MOD	ERĀTE[3]	☐ GOOD[5		RECOVERED[4]	☐ MODE	RÁTE[2] Channe
MONI		☐ FAIR[3] 图 POOR[1	, E	RECOVERING [3] RECENT OR NO RECOVERY [1]	ı 🖭 LOWI	1) Maximum 7 7
Comme	ents				토리 (Herrica) <u>(198</u> 1년 - 1987년 - 1987년	
4] <i>BAN</i>	K EROSIO	N AND RIPAR	IAN ZONE Check	ONE in each category for EACH	BANK (Or 2 per	bank & average)
River r	ight coking downst	ream L R KIPA	KTAN MIDIH T	R FLOOD PLAIN QUA	LITY L	R
	EROSION WE/LITTLE[3:	□□ WIDE:		I FOREST, SWAMP [3] □ SHRUBOR OLD FIELD [2]		CONSERVATION TILLAGE[1]
	XDERATE[2]	□□ NARRO	W5-10m[2]	RESIDENTIAL PARK NEV	VETELDINI 🗆	☐ URBAN OR INDUSTRIAL [0] ☐ MINING/CONSTRUCTION [0]
	avy/sevērē[1] □□ VERYN	ARROW[1]	FENCED PASTURE [1]		predominant land use(s)
		□□ NONE[o] <u></u>	I□ OPEN PASTURE, ROWCR	>P[0] past 100	Om riparian Riparian /
Comme						Maximum // <
5] <i>POO</i>	L/GLIDE A		UN QUALITY			
	MUM DEPT ONE (ONLY!)	A TO THE STREET, AND ASSOCIATED STREET, MANAGEMENT	EL WIDTH	CURRENT VEL	a day to a commercial transition of the	Recreation Potential
■ >1			(Or 2 & average) TH > RIFFLE WIDTH	Check ALL that [2] TORRENTIAL [-1]		(Circle one and comment on back) ☐ Primary Contact
□ 0.7	-<1m[4]	☐ POOL WID	TH = RIFFLE WIDTH	[1] UERYFAST[1]	INTERSTITIA	NL[-1] Secondary Contact
	-<0.7m[2]	☐ POOLWID	TH < RUFFLE WIDTH	[0] 🗆 FAST[1] L	INTERMITTE	NT[-2] Pool/[
□ <0	-<0.4m[1]	A CAN CASE			DDIES[1]	Current -7
Comme	nts			2	r reach – pools :	10
Indicate	e for functional	riffles; Best areas	must be large enougl	to support a population	*****************	**************************************
	-obligate speci			ck ONE (Or 2 & average)		☐ NO RIFFLE [metric = 0]
	DEPTH NREAS > 10cm	RUN DEI MAXIMI	rin RII M>50om⊡i⊡	FLE/RUN SUBSTRATE STABLE(e.g., Cobble, Boulder)	RIFFLE/	RUN EMBEDDEDNESS
□ BEST A	NREAS5-10cm	n[1] 🗆 MAXIMI	JM < 50am[1] □	MOD.STABLE (e.g., Large Grav	ஆப்ப 🖺 🏻	NONE[2] .OW[1] Riffle/
☐ BEST#	NREAS<5cm			UNSTABLE (e.g., Fine Gravel, Sa	nd)[0] 💹 l	400ERATE[0] Run
Comme	(metric nts	=0]				EXTENSIVE [-1] Maximum
6] GRAI	DIENT (7.6		☐ VERYLOW -LON		⊘ %GLID	
DRA	TNAGE ARE		HIGH-VERYHIO		⟨□ %RIFF ⟨□ material of the content of the con	LE: 10
						TOEM 07/06/10

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

	E-ISSUES WW/TP CSO NPDES Industry Uthan Hardered Drit & Grine Contaminated Landfül BMPs: Construction Sediment Logging Injection Coding frosion: Bank Surface Rake bank Manure Lagoon Wash H.O Te H.O Table Mine: Acid Quany Row: Natural Stagnant Westand Pank Golf Lawn Home Atmospheric deposition	
OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)	D-MAINTENANCE □ Public □ Private □ Active □ Historic Succession: □ Young □ Old □ Spray □ Islands □ Soured Srag : □ Removed □ Modified Levect: □ One sided □ Both banks □ Refocated □ Outoffs Bedoed: □ Moving □ Stable □ Armoured □ Stamps □ Impounded □ Desiccated □ Rood control □ Desircated	
udies QHEI (Qualitative	C-RECREATION Area Depth Pool: □ > 100 ft² □ > 3 ft. seperant ge	EBUK A BOOK
OWQ Biological St.	Oil sheen	100 mg/m
VENT	A-CANOPY B-AESTHETICS Strong Nuisance algae Oil sheen Stwo-Open Invasive macrophytes Trash/Liths Prod: Stwo-< 55% Excess furthidity Nuisance odor 10% -< 30% Excess furthidity Nuisance odor 10% -< 30% Excess furthidity Studge deposits < 10% - Cosed Foam/Soum CSOs/SSOs/Outfalls Left Middle Right Total Average % open % ow	ing: A53
COMMENT	A-CANOPY > 85%-0pen 55%-85% 10%-630% 10%-630% codrg upstram(>10	Stream Drawing:

STREAM NAME	LOCATION
STATION# REACHID#	STREAM CLASS
UTMIN UTM E	RIVER BASIN
STORET#	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE REASON FOR SURVEY TIME PM

Habitat		Conditio	n Category	
Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover, mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat, habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat, lack of habitat obvious; substrate unstable or lacking.
SCORE S	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent, root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant, some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedroo no root mat or vegetatio
SCORE 🔏	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 (
3. Pool Variability	Even mix of large- shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large- deep, very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 (
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development, more than 80% of the bottom changing frequently; por almost absent due to substantial sediment deposition.
SCORE 1 D	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status		Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools
SCORE &	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat		Conditio	on Category	
Parameter	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal: stream with normal pattern.	Some channelization present, usually in areas o bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive, embankments or shoring structures present on both banks, and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabic or cement, over 80% of the stream reach channelized and disrupte Instream habitat greatly altered or removed entirely.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8)7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length I to 2 times longer than it it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2/1)0
8, Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	areas of erosion, high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE 🎸 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more	surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble	Less than 50% of the streambank surfaces covered by vegetation, disruption of streambank vegetation is very high; vegetation has been emoved to 5 centimeters or less in average stubble height.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	6 4 3	2 1 0
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0
IO. Riparian /egetative Zone Vidth (score each ank riparian zone)	>18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	18 meters; human activities have impacted a	12 meters; human nactivities have impacted r	Vidth of riparian zone <6 neters: little or no iparian vegetation due to uman activities.
CORE(LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
CORE 🦸 (RB)	Right Bank 10 9		5 4 3	

Total Score / 52

Multi-habitat (MHAB) Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

IDEM	The second second	OWQ Bialog	ical Studies (bioSample #	HEI (Qualita) Stream		tat Evalua	tion Inde:	x)	. Sec
	4<-	44	The second of th	Containing a second of the containing of the con	04 L.T.	and the state of t	38.16/2	2 - 87.4	15476
11	Surveyor	Sample Date	County	Macro Samp		Ⅲ Habitat	T		
	ECOTEUR	8/21/17	Warrek	MHAR		Complete	QHEI S	icore:	53
1] 5	UBSTRATE (Theck ONLY Two p estimate % and	predominant substra check every type p	te TYPE BOXES;		Check ONE (0)r 2 & average)		
PREDOMI	BEST TYPE	PRESENT TOTAL %	PREDOMINANT	HER TYPES PRESENT TOTAL	W	GIN		ALITY	
Towns and the	BLDR/SLABS[1 BOULDER[9]	oj 🖺	PR □ ■ HARDPAN □ □ DETRITUS		UIMES TILLS[WETLA		S HEAV ↑ MOD ↓ NORI	ERATE [-1]	Substrate
	COBBLE[8] GRAVEL[7]		☐☐ MUCK[2] ■☐ SILT[2]		M HARDP				\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
	SAND [6] BEDROCK [5]		□□ ARTIFICIA (Score natur	al substrates; Ignore	☐ RIP/R/ □ LACUST	NP[0] TRINE[0]		NSIVE [-2] ERATE [-1]	씰
	ere en la gazzañ e en en eus even. La caractería da		more [2] sludge i less [0]	from point-sources)	☐ SHALE ☐ COALF	[-1] INES [-2]	R☐ NORI		Maximum 20
Comn		11/57	* * * 1						
quality; quality i that is s % Amou	2 Moderate am in moderate or g table, well deve unt UNDERCUT BA OVERHANGIN	ounts, but not of I preater amounts (e loped root wad in WKS [1] G VEGETATION [1 NSLOW WATER)	righest quality or in e.g., very large boul deep/fast water, or se Angunt L POOLS C ROOTV	VADS[1] 💹 🛚	ghest quality; water, large di functional poo out OXBOWS, B. AQUATICM	3 -Highest ameter log	Check OF EXTEN MODE!	AMOUNT NE (Or 2 & av SIVE > 75° RATE 25 - 7 E 5 - < 25° Y ABSENT - Cover Maximum	/erage) /6[11] 5%[7] 6[3] <5%[1]
Comn	nents		ert etc.					20	لكا
SINU HIGH	OSITY iH[4] DERATE[3] V[2] NE[1] 1ents	DEVELO	PPMENT ENT[7] [5]] 1]	ategory (Or 2 & aver CHANNELIZAT NONE[6] RECOVERED[4] RECOVERING[: RECENT OR NO	FION 3] RECOVERY[1] [] row	[3] ERATE[2] [1]	Channe Maximun 20	
L R	EROSION ONE/LITTLE [3 ODERATE [2] IEAVY/SEVERE	tream R RIPA BB WIDE MODE	ARIAN WIDTH > 50m[4] RATE 10-50m[3] OW5-10m[2] NARROW[1]	ck ONE in each cate L R FLOOD P C FOREST, SM C SHRUB OR RESIDENTI FENCED PA	LAIN QUA VAMP[3] OLD FIELD[2 AL, PARK, NEI STURE[1]	LITY C C J WFIELD[1] C Indicat	R I□ CONSERV I□ URBANO	ATION TILL R INDUSTRI CONSTRUC	AL[O] IION[O]
		AND RIFFLE	RUN QUALITY			-		10	<u> </u>
MAX: Check □ > ■ 0 □ 0 □ Comm	IMUM DEPT ONE (ONLY!) ·1m[6] .7 - < 1m[4] .4 - < 0.7m[2] .2 - < 0.4m[1] :0.2m[0] ients	CHANI Check ONI POOLWI POOLWI POOLWI POOLWI	NEL WIDTH E (Or 2 & average) DITH > RIFFLE WID DITH = RIFFLE WID DITH < RIFFLE WID	CUF OTH[2] TORR OTH[1] VERY OTH[0] FAST[MOOR	1]	apply SLOW[1] INTERSTITE INTERMITT DEDOIES[1] or reach - pools	(Grde o □ AL[-1] □ ENT[-2] and riffles.	creation Pote ne and comme Primary Cont Secondary Co Pool/ Current Maximum 12	ntonback) act antact
RIFFL BES BES	ate for functiona tie-obligate spec LE DEPTH TAREAS > 10cm TAREAS < 5 cm [metrik	I riffles; Best area les; RUN D m[2]	s must be large end EPTH F MUM > 50cm [2] [MUM < 50cm [1] [ugh to support a po Check ONE (Or 2 & RIFFLE/RUN SI STABLE(e.g., Col MOD. STABLE(e.g., UNSTABLE(e.g.,	pulation average) UBSTRATE bble, Boulder) .g., Large Grav	RIFFLE [2] [2] [3] [4][1] [3] [5] [6]	12.0	FRLE[metric EDDEDNE Riffle/] Run	<u>=0]</u>
		:4rt/mi) ,05%	☐ VERY LOW -	LOW[2-41 9	%POOL:	<1%GLI	DE: (इटा)	Gradient	三
		EA (1972.4mi²)	MODERATE (5-10]	· ·	≤ %RIFF		Maximum 10	8
								15	EM 07/06/10

Multi-habitat (MHAB) Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

	E-ISSUES WWYTP CSO NPDES Industry Urban Hardened Dit & Gime Contaminated Landfill BMPs: Construction Seriment Logging Imigation Coding Frosion: Bank Surface Rake bank Manure Lagoon Wash HyO Tife HyO Table Mine Aod Quany Flow: Natura Sagnant Wetband Park Golf Lawn Home	otriblico iacci
OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)	D-MAINTENANCE □ Pubic □ Private □ Active □ Historic Successori:□ Young □ Old □ Spray □ Reinste ■ Scoured Srag :□ Removed □ Modified Levecti:□ One sided □ Both banks □ Reforated □ Cutoffs Bedood: ■ Mowing □ Sable □ Armound □ Stangs □ Impounded □ Desirage	
tudies QHEI (Qualitative	C-RECREATION Area Depth Area Depth Poot > 1000f² > 3ft	Stavley Road
OWQ Biological S	A-CANOPY B-AESTHETICS □ >85% - Open □ Nuisance agae □ Oil shean □ 10% - < 55% □ Invasive macrophytes □ Tricati/Litter Poot □ □ 30% - < 55% □ 10% - < 30% □ Discolation □ Studge deposits □ < 10% - Closed □ Foam/Soum □ CSOs/SSOs/Outfalls Lody gupthtem (> 10m, 3 readings, < 10m, 1 reading m mixtle); Roud to the restext whole pertent Left Mixtle Right Total Average % open % % % % % % % % %	
COMMENT	A-CANOPY B-AEST > 88%-0pen	Stream Drawing:

STREAM NAME	LOCATION AS 6 (North) > ACCURACY PUB
STATION# REACH ID#	STREAM CLASS
UTM N UTM E	RIVER BASIN
STORET#	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE REASON FOR SURVEY TIME PM

Habitat		Conditio	n Category	et i grand et Samertin i de la Samertin de la Same La Samertin de la Sam
Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover, mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat i obvious; substrate unstable or lacking.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent, root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedroe no root mat or vegetation
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 (
3. Pool Variability	Even mix of large- shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large- deep, very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.
score 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; poo almost absent due to substantial sediment deposition.
SCORE / >	20 19 18 17 16	15 14 13 12 11	(0) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools
SCORE / C	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Habitat	Condition Category							
Parameter	Optimal	Suboptimal	Marginal	Poor				
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks, and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gab or cement, over 80% o the stream reach channelized and disrup Instream habitat greati				
SCORE /	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) (
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length I to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length I to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.				
SCORE /	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) (
8. Bank Stability (score each bank)	Banks stable, evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas: "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE (LB)	Left Bank 10 9	(8), 7 6	5 4 3	2 1 0				
SCORE (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0				
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not	surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more	surfaces covered by vegetation, disruption obvious, patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.				
SCORE (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0				
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				
10. Riparian Vegetative Zone Width (score each bank riparian zone) Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cu lawns, or crops) have i impacted zone.		18 meters; human activities have impacted ε	12 meters; human r activities have impacted r	Width of riparian zone <6 neters: little or no riparian vegetation due to numan activities				
SCORE(LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0				
SCORE 🥍 (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0				

Total Score <u>96</u>

Multi-habitat (MHAB) Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

IDEM		WQ Biologi	cal Studies Q					
#	Sample #	e.	bioSample #	Stream	Name OU CreeK	to be control or manufacture of the control of the	Scation 8-06617:-8	7, 10757
M	Surveyor	Sample Date	County	Macro Samp		labitat	0,062,010	
P.A	Es-Tech]	विश्वद्यान	Wattick			iplete 🕻	HEI Score	: 52
1] <i>SU</i>	BSTRATE CI	reck ONLY Two pr	edominant substrate	TYPE BOXES;				
PREDOMINA	EST TYPES		The state of the s	ISENT I ER TYPES PRESENT TOTAL W	ORIGIN	ick ONE (Or 2	& average) QUALITY	
PR		PR	PR	PR	☐ LIMESTONE	[1]	E HEAVY[-2]	
	.DR/SLABS[10 XULDER[9]		☐☐ HARDPAN[☐☐ DETRITUS]		☐ TILLS[1] ☐ WETLANDS		Î∏ MODERATE[□ NORMAL[0]	
$\Box\Box$ α	DBBLE [8]		□□ MUCK[2]		☐ HARDPAN [ŎŢ	FREE [1]	50030 NC
UU GI ■U SA	RAVEL[7]	88	■□ SILT[2] □□ ARTIFICIAL	m 日日	☐ SANDSTONE ☐ RIP/RAP[0]		EXTENSIVE [-21 6
□□ BE	DROCK[5]		(Score natural	substrates; ignore			☐ MODERATE [
		「TYPES: ☐ 4 or i☐ 3 or i	more [2] sludge fro ess [0]	om point-sources)	☐ SHALE [-1] ☐ COAL FINES	[-2]	☐ NORMAL[0] ☐ NONE[1]	Maximum 20
Commo		1/ED 10:0:						
quality; 2 quality in that is sta	Moderate amo moderate or gr ble, well develo	unts, but not of hi eater amounts (e.	ghest quality or in s g., very large boulde leep/fast water, or d	mall amounts of hig ars in deep or fast v	hest quality; 3 -Higi <i>r</i> ater, large diamete	hest er log 	if more common of r AMOUN Check ONE (Or 2 EXTENSIVE >	NT & average) 75% [11]
% Amount <u> </u>	INDERCUT BAI	NKS[1]			OXBOWS, BACKN	ATERS[1]	☐ MODERATE 25 ☐ SPARSE 5 - < 2	5%[3]
/ 6	XVERHANGING HALLOWS ON	VEGETATION [1	Rootw. []	ADS[1] RS[1] 202	AQUATIC MACRO LOGS OR WOODY		☐ NEARLY ABSET	
	OOTMATS[1]	Section Training	d 17 poot 15	10[1] <u>av</u> F	LOGSONWOODI	DEDICED[1]	Maxim	um /
Comm	ents					The second second		20
□ HαGH	ISTEY [4] ERATE[3] [2]	PHOLOGY Ch DEVELO DEVELU DEVCELU DEVCELU DEVCELU DEVCELU DEVCELU DEVELOGY D	ENT [7] [25]	HANNELIZAT NONE[6] RECOVERED[4]	ION 1	STABILIT HIGH[3] MODERA LOW[1]	Call sta	
Comme								لككا
L R NO	ight looking downston EROSION WE/LITTLE [3] DERATE [2] AVY/SEVERE [1	RIPA RIPA ME WIDE: MODE	VATE 10-50m[3] XW 5-10m[2] VARROW[1]	_{LR} FLOOD PL ☑	.AIN QUALITY AMP[3] XLD FIELD[2] L, PARK, NEW FIEI TURE[1]	Indicate pr	CONSERVATION TO URBAN OR INDUS MINING / CONSTR edominant land use(TRIAL[0] LUCTION[0]
	<i>L/GLIDE A</i> MUM DEPTI		UN QUALITY			-		
Check 0	DNE (ONLY!) m[6] -<1m[4] -<0.7m[2] -<0.4m[1] .2m[0]	Check ONE POOLWIE POOLWIE	IEL WIDTH (Or 2 & average) TH > RIFFLE WIDT TH = RIFFLE WIDT TH < RIFFLE WIDT	☐ H[2] ☐ TORRE H[1] ☐ VERYE	RATE[1] Indicate for reac	OW[1] TERSTITIAL TERMITTEN DIES[1] the pools and	[[-2] Po Curre Friffles Maximi	nonert on back) Contact ry Contact ol/
Indicati	e for functional	riffles; Best areas	must be large enou		ulation	inianioni mini		***************************************
RIFFLE	-obligate specie DEPTH	RUN DE	PTH RI	neck ONE (Or 2 & a CFFLE/RUN SU	IBSTRATE I		☐ NORIFFLE[me	The state of the s
☐ BEST /	AREAS > 10cm AREAS 5 - 10cm	1[1] MAXIM	UM>50am[2] 🗌 UM<50am[1] 🗍	MOD.STABLE(ed	oie, bouider)[2] j., Laige Gravel)[1]	l □ rov		le/N7
BEST A Comme	AREAS < 5 cm metric :			UNSTABLE (e.g., F		0] 🗆 MO	the second of second of the W	un 4
	DIENT (2, 64	∤ fc/mi)	☐ VERYLOW -LC		POOL: 70	%GLIDE:		
			MODERATE [6-	10]	لنكتك	%RIFFLE	Maximu	im 8
								ICEM 07/06/10

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

	E-ISSUES WWTP CSO NPDES Industry Urtan Hardened Dirt & Girne Contaminated Landfill BWPs: Construction Sediment Logging Impation Sediment Hardened Landfill BWPs: Construction Sediment Hoxistic Bank Surface False bank Manure Lagoon Wash H.,O Tile H.,O Table Mine: Add Quany How: Natural Stagnant Wettand Park Golf Lawn Home		01/90/20 NACS
OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)	D-MAINTENANCE Public Private Active Historic Successor: Young Ood Spray Lislands Scouned Spray Lislands Modified Leveed: One sided Both hanks Redocated Cotoffie Redocated Cotoffie Amounded Desicrated Thood control Desirage		/ 3 ^x
dies QHEI (Qualitative	C-RECREATION Area Depth Area Depth Area Depth Pool: > 3000 > 3000 Depth Read		
OWQ Biological Stu	B-AESTHETICS Nuisance algae Olsthean Invasive macrophytes Trash/Lithar Root Excess turkdity Nuisance odor Decoloration Sludge deposits Foam/Soum CSOs/SSOs/Outfalls fright Total Average 90	A Secretary of the secr	
COMMENT	A-CANOPY -> 88-0-Open	Stream Drawing:	interior programming and the control of the control



HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

STREAM NAME	LOCATION
STATION#REACH ID#	STREAM CLASS
UTM N. UTM E.	RIVER BASIN
STORET#	AGENCY
INVESTIGATORS	
FORM COMPLETED BY	DATE REASON FOR SURVEY TIME PM

Habitat		Conditio	n Category	
Parameter	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient)	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent, root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedroe no root mat or vegetation
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large- shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large- deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small- shallow or pools absent.
score 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; poo almost absent due to substantial sediment deposition.
SCORE / D	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE /	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

	Habitat		Condition Category									
	Parameter	Optimal	Suboptimal	Marginal	Poor							
	6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.							
	SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0							
ling reach	7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length I to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.							
sampl	SCORE.	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0							
Parameters to be evaluated broader than sampling reach	8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.							
eva	SCORE 7 (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0							
to be	SCORE 7 (RB)	Right Bank 10 (9/	8 7 6	5 4 3	2 1 0							
Parameters	9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation, disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.							
	SCORE & (LB)	Left Bank 10 9	(8 7 6	5 4 3	2 1 0							
	SCORE ∜ (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0							
	10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.							
	SCORE / (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0							
	SCORE / (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0							

Total Score 107

		***************************************					-		******************************						
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Scale: 1 square = _

APPENDIX C.

RAW DATA-WATER CHEMISTRY, MACROINVERTEBRATES, FISH



Eco-Tech Consultants, Inc.

311 Clark Station Road

Fisherville, KY 40023

Lab Number:

2017-0199-01

Date Received:

8/29/2017

Date Reported:

9/8/2017

Sample Identification

AS-1

Date Sampled:

8/29/2017

Time Sampled:

Sampled by:

Sample Analysis

Parameter	Result	Method	Analyst	Analysis Da	ate/Time
Acidity as CaCO3	<10 mg/	/L SM 2310 B-1997	CRB	9/1/2017	8:31
Alkalinity as CaCO3	313 mg/	/L SM 2320 B-1997	CRB	9/1/2017	8:31
Iron	0.16 mg/	/L SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017	13:00
Metals Analysis Preparation	Completed	EPA 200.7 Rev. 4.4	CRB	9/5/2017	9:10
Manganese	<0.1 mg/	/L SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017	15:10
Solids, Total Suspended *** Performed by client	<10 mg/	/L SM 2540 D-1997	CVB	9/1/2017	8:45

Reviewed by Rodge Wills



Eco-Tech Consultants, Inc.

311 Clark Station Road

Fisherville, KY 40023

Lab Number:

2017-0199-02

Date Received:

8/29/2017

Date Reported:

9/8/2017

Sample Identification

AS-2

Date Sampled:

8/29/2017

Time Sampled:

Sampled by:

Sample Analysis

Parameter	Result		Method	Analyst	Analysis Da	ate/Time
Acidity as CaCO3	<10 mg	g/L	SM 2310 B-1997	CRB	9/1/2017	8:31
Alkalinity as CaCO3	280 mg	g/L	SM 2320 B-1997	CRB	9/1/2017	8:31
Iron	<0.1 mg	g/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017	13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017	9:10
Manganese	<0.1 mg	g/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017	15:10
Solids, Total Suspended *** Performed by client	10 mg	g/L	SM 2540 D-1997	CVB	9/1/2017	8:45

Reviewed by Rodge Wills



Eco-Tech Consultants, Inc.

311 Clark Station Road

Fisherville, KY 40023

Lab Number:

2017-0199-03

Date Received:

8/29/2017

Date Reported:

9/8/2017

Sample Identification

AS-3

Date Sampled:

8/29/2017

Time Sampled:

Sampled by:

Sample Analysis

Parameter	Result	Method	Analyst	Analysis Date/Time
Acidity as CaCO3	<10 mg/L	SM 2310 B-1997	CRB	9/1/2017 8:31
Alkalinity as CaCO3	256 mg/L	SM 2320 B-1997	CRB	9/1/2017 8:31
Iron	<0.1 mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017 13:00
Metals Analysis Preparation	Completed	EPA 200.7 Rev. 4.4	CRB	9/5/2017 9:10
Manganese	<0.1 mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017 15:10
Solids, Total Suspended *** Performed by client	11.7 mg/L	SM 2540 D-1997	CVB	9/1/2017 8:45

Reviewed by Rodge Wills



2017-0199-05

8/29/2017

9/8/2017

Eco-Tech Consultants, Inc.

311 Clark Station Road

Fisherville, KY 40023

Sample Identification

AS-6

Date Sampled: 8/29/2017

Time Sampled:

Lab Number:

Date Received:

Date Reported:

Sampled by: ***

Sample Analysis

Parameter	Resu	lt	Method	Analyst	Analysis Da	ate/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017	8:31
Alkalinity as CaCO3	255	mg/L	SM 2320 B-1997	CRB	9/1/2017	8:31
Iron	0.18	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017	13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017	9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017	15:10
Solids, Total Suspended *** Performed by client	23.0	mg/L	SM 2540 D-1997	CVB	9/1/2017	8:45

Reviewed by Rodge Wills



Eco-Tech Consultants, Inc.

311 Clark Station Road

Fisherville, KY 40023

Lab Number:

2017-0199-04

Date Received:

8/29/2017

Date Reported:

9/8/2017

Sample Identification

AS-5

Date Sampled:

8/29/2017

Time Sampled:

Sampled by:

Sample Analysis

Parameter	Resu	ılt	Method	Analyst	Analysis Da	ate/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017	8:31
Alkalinity as CaCO3	344	mg/L	SM 2320 B-1997	CRB	9/1/2017	8:31
Iron	<0.1	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017	13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017	9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017	15:10
Solids, Total Suspended *** Performed by client	<10	mg/L	SM 2540 D-1997	CVB	9/1/2017	8:45

Reviewed by Rodge Wills

Raw Macroinvertebrate data collected 8/28-29/2017 from streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

AQUATIC SITE				AS1	AS2	AS3	AS5	AS6
DATE				8/29/17	8/29/17	8/29/17	8/28/17	8/29/17
SPECIES	T.V.	F.F.G.	Habit					
PLATYHELMINTHES								
Turbellaria								
Tricladida								
Planariidae								
Girardia (Dugesia) tigrina					1			
MOLLUSCA								
Bivalvia								
Veneroida								
Corbiculidae								
Corbicula fluminea	6	FC		8				6
Gastropoda								
Basommatophora								
Physidae								
Physella sp.	8	SC		1		1		
ANNELIDA								
Oligochaeta	8	GC	bu					
Clitellata								
Tubificida								
Naididae	8	GC						
Naidinae								
Nais pardalis	8	GC			1			
Tubificinae w.o.h.c.	10	GC	bu	1	1		3	
Pristininae								
Pristina sp.	8	GC			1			
Pristina aequiseta	8	GC			3			
Rhyacodrilinae								
Branchiura sowerbyi	6	GC	bu		3		1	
ARTHROPODA								
Arachnoidea								
Acariformes								
Oribatei							1	
Crustacea								
Amphipoda								
Talitridae								
Hyalella azteca	8	GC	cr	5		6		9

Asellidae								
Caecidotea sp.	8	GC	cr	2				
Insecta								
Collembola								
Sminthuridae								1
Ephemeroptera								
Baetidae								
Callibaetis floridanus		GC		3		10	1	3
Caenidae								
Caenis sp.	3	GC	sw		4		1	
Odonata								
Calopterygidae								
Calopteryx sp.	4	PR						2
Hetaerina sp.	3	PR					1	
Coenagrionidae						1		
Argia sp.	5	PR		1	4	3		1
Enallagma sp.	9	PR		2	1	6	1	1
Ischnura sp.	9	PR	cb	2	1	4		1
Corduliidae								
Epitheca princeps		PR	sp			2		
Macromia sp.	2	PR		1				
Libellulidae				1		1		
Erythemis sp.	2	PR		2				
Libellula sp.	9	PR						1
Pachydiplax longipennis		PR						3
Heteroptera								
Belostomatidae		PR		2				
Gerridae		PR						
Aquarius		PR	sw			1		
Nepidae								
Ranatra sp.		PR				3		
Megaloptera								
Corydalidae								
Corydalus cornutus	2	PR		3			1	
Trichoptera								
Hydropsychidae							4	4
Hydropsyche sp.	4	FC	cn	10	1	1	9	4
Cheumatopsyche sp.	3	FC	cn	57	87		79	20
Hydroptilidae								
Hydroptila sp.	3	SC	cn				6	2
Neotrichia sp.	4	SC					4	
Polycentropodidae								
Neureclipsis sp.	3	FC		1			1	

Coleoptera								
Dytiscidae		PR				1		
Elmidae								
Stenelmis sp.	5	SC	cn			1		
Gyrinidae								
Dineutus sp.	4	PR		2				8
Haliplidae								
Peltodytes sp.	7	SH	cb				1	1
Hydrophilidae								
Berosus sp.	7	PR		1			2	
Diptera								
Chaoboridae								
Chaoborus punctipennis						1		
Chironomidae	6	FC				1		
Chironominae								
Chironomini								
Chironomus sp.	8	GC	bu	1		1	59	
Cryptochironomus sp.	5	PR	sp			1	7	1
Cryptotendipes sp.	4	GC	bu			2		
Dicrotendipes	_			_				_
neomodestus	5	FC		5		12	10	4
Endochironomus sp.	6	SH	cn			1		
Glyptotendipes sp.	6	FC	bu	3	82	1		2
Parachironomus sp.	4	PR	sp		1	1		
Paracladopelma sp.	7	GC					3	
Phaenopsectra obediens group		ОМ				2		
Polypedilum flavum		Olvi		28	3	2	3	4
Polypedilum halterale				20	3		3	7
group						1		
Polypedilum illinoense								
group	7			23	1	24	133	39
Polypedilum sp.		SH	cb		1			
Tribelos fuscicorne							7	1
Tribelos jucundus								1
Pseudochironomini								
Pseudochironomus sp.							59	
Tanytarsini								
Cladotanytarsus sp.	4	GC	cb	1		1		
Paratanytarsus dissimilis Rheotanytarsus exiguus						2		
gp.		FC			11			
Tanytarsus sp.	4	FC	cb	1	3	2	3	6
Orthocladiinae								

Corynoneura sp.	4	GC	sp	1				
Cricotopus bicinctus	7	OM		3			14	2
Rheocricotopus robacki	4			1				
Thienemanniella xena	4	GC						2
Tanypodinae								
Ablabesmyia mallochi Ablabesmyia rhamphe	5	ОМ		6		10	3	4
group				9		5		2
Conchapelopia sp.	4	PR		20		5	66	7
Labrundinia sp.	4	PR	sp			1		
Procladius sp.	7	PR	sp	4		8	7	8
Telopelopia okoboji	4			5				
Empididae							1	
Hemerodromia sp.			sp				3	
Muscidae	6	PR					1	
Simuliidae								
Simulium sp.	5	FC	cn		2			

Raw fish data collected 8-29-17 from streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

Species	Common Name	AS 1	AS2	AS3	AS5	AS6	Family/Group	IBI Trophic Guild Assignment	IBI Sensitivity	Repro. Guild	Pioneer?	Schooling?
Ameiurus natalis	yellow bullhead		1				Ictaluridae	V	T	С		
Amia calva	bowfin			1			Amiidae	С		С		
Aphredoderus sayanus	pirate perch			1			Aphredoderidae	V		M		
Cyprinella whipplei	steelcolor shiner				11		Cyprinidae	V		M		TRUE
Gambusia affinis	mosquitofish				1	12	Poeciliidae	V		N		
Ictalurus punctatus	channel catfish			1			Ictaluridae	С	Т	С		
Lepomis cyanellus	green sunfish	4	5	7	8		Sunfish	V	Т	С	TRUE	
Lepomis gulosus	warmouth	2	4	1		1	Sunfish	С		С		
Lepomis macrochirus	bluegill	10	15	3		4	Sunfish	V		С		
Lepomis megalotis	long-eared sunfish	4		3		2	Sunfish	V	SI	С		
Lepisosteus osseus	longnose gar				1		Lepisosteidae	С	T	М		
Micropterus punctulatus	Kentucky bass	1		1	1	1	Centrarchidae	С		С		
Micropterus salmonoides	largemouth bass		4				Centrarchidae	С		С		
Percina sciera	dusky darter				1	1	Percidae	V	s	S		
Phenacobius mirabilis	suckermouth minnow	4			20		Cyprinidae	V		s		TRUE
Pimephales notatus	bluntnose minnow	5			7		Cyprinidae	D	T	С	TRUE	TRUE
# individuals		30	29	18	50	21			-			-
# species		7	5	8	8	6						
% deformed		3.33%	3.45%	0.00%	0.00%	0.00%						
Total Individuals	·						77					

^{*} exotic species

<u>IBI Trophic Guild Assignment</u> = Detritivore-D, Omnivore-O, Invertivore-V, Insectivore-I, Carnivore-C

<u>IBI Sensitivity</u> = Sensitive-S, Intolerant-I, Both Sensitive & Intolerant (SI), Tolerant-T

Reproductive Guild = Simple lithophil-S, Complex with parental care-C, Simple miscellaneous-M, Complex with no parental care-N

APPENDIX D.

DATA TABLES OF PREVIOUS SURVEY EFFORT (2011)-WATER CHEMISTRY, MACROINVERTEBRATES, FISH

Appendix D Table 1. Stream characteristics at aquatic sample sites within the proposed Seven Hills Mine in Warrick County, Indiana.

Sample Site	Stream	Flow Regime	Bankfull Width (ft)	Mean Bankfull Depth (ft)	Slope	Channel Material	RBP Score	Rosgen Stream Type*
AS1	6	Per	45.1	2.7	0.03	Silt	126	F5/F6
AS2	5	Int	6.5	0.3	0.01	Gravel	47	C6
AS3	11	Per	63	2.6	0.02	Silt	126	F5/F6

^{*}Rosgen 1996

Appendix D Table 2. Physical and chemical measurements of water in streams withinthe proposed Seven Hills Mine in Warrick County, Indiana as compared to Indiana NPDES dischage standards and Minimum Surface Water Quality standards.

Parameter	AS1	AS2	AS3	NPDES Discharge Limits	Surface Water Quality Standards
Temperature (°C)	17.5	17.5	18.9	≤32.2	≤32.2
Flow Rate (ft/second)	0.72	0.31	1.12	NA	NA
pH	8.3	8.8	8.4	6.0 - 9.0	6.0 - 9.0
Total Dissolved Solids (mg/L)	1588	863	1129	NA	<750
Total Acidity (mg/L as CaCo3)	<10	<10	<10	NA	NA
Total Alkalinity (mg/L as CaCo3)	380	330	280	NA	NA
Total Iron (mg/L)	0.79	0.1	0.47	<6.0	NA
Total Manganese (mg/L)	0.19	0.02	0.066	<4.0	NA
Total Suspended Solids (mg/L)	39	24	25	<70	NA

Appendix D Table 3. Metrics used to calculate the macroinvertebrate Index of BioIntegrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

Parameter	AS	51	AS2		AS	3
	Value	Score	Value	Score	Value	Score
Number of Taxa	8	1	19	1	18	1
Number of Individuals	26	1	86	1	129	3
Number of EPT Taxa	1	1	1	1	3	1
% Orthocladiinae + Tanytarsini of Chironomidae	0.0%	5	0.0%	5	14.3%	5
% Non-insects Minus Crayfish	5.4%	5	19.8%	3	9.3%	5
Number of Diptera Taxa	1	1	6	1	3	1
% Intolerant	7.7%	1	11.6%	1	39.5%	5
% Tolerant	11.5%	5	14.0%	3	0.8%	5
% Predators	42.3%	5	59.3%	5	20.9%	3
% Shredders + Scrapers	15.4%	3	15.1%	3	31.0%	5
% Collector-Filterers	7.7%	5	11.6%	3	36.4%	1
% Sprawlers	0.0%	1	3.5%	3	0.0%	1
Total Scores		34		30		36

^{*&}lt;36=impaired, >36=unimpaired.

Appendix D Table 4. Fish community metrics used to calculate the Index of Biotientegrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

	AS1		AS	2	AS	S3
Parameter	Value	Score	Value	Score	Value	Score
Number of Species	13	5	7	1	18	5
Number of Minnow Species	2	3	1	1	5	3
Number of Sunfish Species	5	5	2	3	5	5
Number of Sucker Species	0	1	0	1	0	1
Number of Sensitive Species	0	5	0	1	1	1
% Tolerant	21%	5	50%	3	22%	5
% Omnivore	5%	5	2%	5	4%	5
% Insectivore	84%	5	98%	5	84%	5
% Pioneer	11%	5	NA		NA	
% Carnivore	NA		2%	1	13%	3
Total # Individuals	62	1	148	3	85	1
% Simple Lithophilic Individuals	2%	1	0%	1	1%	1
% Individuals with Deformities	2%	3	1%	5	0%	5
Total Scores		44		30		40
Qualitative Rating*		Fair		Poor		Fair

^{*58-60=}Excellent, 48-52=Good, 40-44=Fair, 28-34=Poor, 12-22=Very Poor, <12=No Fish